IMPLEMENTATION OF THE KMB DIGITAL EDUCATION APPLICATION ON COMPLIANCE AND WOUND HEALING OF POST-ABDOMINAL SURGERY PATIENTS AT PEMANGKAT REGIONAL HOSPITAL

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ABSTRACT
Background: Health education is a crucial component in improving patient adherence to wound care, particularly among individuals recovering from abdominal surgery. Improper wound care can increase the risk of infection and delay the healing process. The integration of digital technology in healthcare provides innovative solutions for patient education. The KMB Digital Education Application serves as a medium to enhance patients' understanding of postoperative wound management, enabling them to follow care instructions more consistently and achieve faster recovery.
Objectives: This study aimed to determine the effect of the KMB Digital Education Application on patient adherence and wound healing among post-abdominal surgery patients at Pemangkat Regional Hospital.
Methods: This research employed a quasi-experimental design with a pretest-posttest control group approach. A total of 50 post-abdominal surgery patients were selected using purposive sampling and divided equally into intervention and control groups. The intervention group received education through the KMB Digital Application, while the control group received standard education. Data were collected using observation sheets and analyzed using Repeated Measure ANOVA.
Results: The findings revealed a significant improvement in patient adherence within the intervention group, increasing from 31.12 ± 1.20 to 46.44 ± 1.56, compared to the control group, which only rose from 28.68 ± 1.07 to 33.24 ± 0.97 ($p < 0.001$). Wound healing outcomes also showed significant differences between groups, where the intervention group's healing scores improved from 42.32 ± 2.19 to 21.84 ± 2.19, while the control group improved from 42.36 ± 1.87 to 36.48 ± 1.16 ($p < 0.001$).
Conclusion:The implementation of the KMB Digital Education Application significantly enhances patient adherence to wound care and accelerates wound healing among post-abdominal surgery patients. The use of digital education technology can therefore be an effective innovation to support postoperative recovery and improve the quality of nursing care.

Keywords: Digital Application, Patient Adherence, Wound Healing, Post-Abdominal Surgery

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BACKGROUND

Surgery is one of the most frequently performed medical procedures in various hospitals as a treatment for diseases that cannot be managed with conservative therapy. After surgery, the patient's recovery phase is highly dependent on optimal wound healing. Surgical wounds, especially those in the abdominal area, require special attention due to the high risk of complications such as infection, wound dehiscence, and delayed healing due to patient non-compliance with wound care (Anderson, 2021). Globally, postoperative wound complications remain a major cause of prolonged hospitalization and increased healthcare costs, with infection rates reaching 10–20% depending on surgical type and hospital environment (WHO, 2020).

Patient compliance with post-operative care plays a crucial role in wound healing outcomes. Lack of understanding and education often leads to patients ignoring medical instructions, failing to change dressings as directed, and ignoring early signs of infection (Nursalam, 2020). Previous research has shown that the rate of non-compliance among post-abdominal surgery patients in Indonesia remains high, with wound complications reaching 25–30% of total major surgical cases (Ministry of Health, 2022). Non-adherence not only delays the healing process but also increases the likelihood of rehospitalization, antibiotic use, and the burden on healthcare resources.

Additionally, environmental and cultural factors, as well as limited access to health education, influence patient behavior. Most patients in non-urban areas struggle to receive ongoing education after hospital discharge, even though the home care phase is crucial for the quality of recovery (Sari, 2023). This disconnect between patients and healthcare professionals during the home care phase often presents a barrier to maintaining continuity of nursing care. Conventional health education, such as brief counseling or printed materials, is often insufficient to ensure consistent understanding and compliance, as patients may forget instructions or lack motivation for self-care. Furthermore, family support, literacy levels, and access to information technology also play a determining role in shaping adherence behavior.

In the framework of behavioral health theories, such as the Health Belief Model (HBM) and Self-Efficacy Theory, patient adherence is influenced by the individual's perceived susceptibility to complications, perceived benefits of action, and confidence in performing care activities. Digital education can strengthen these psychological components through repetitive learning, visual demonstration, and feedback features that reinforce behavioral change (Putri, 2021). By integrating multimedia elements and real-time reminders, digital health tools promote active patient participation and empower individuals to take responsibility for their health outcomes.

Digital transformation in nursing opens up significant opportunities to improve the effectiveness of health education. The use of digital applications allows patients to access information, receive guidance, and independently monitor adherence under remote supervision by healthcare professionals. Studies have shown that digital-based nursing education improves health literacy, strengthens self-efficacy, and accelerates wound healing (Rahmawati, 2022). Moreover, digital technology bridges communication gaps between patients and nurses, especially in rural or resource-limited settings, where distance and limited manpower often hinder continuous patient engagement.

As an innovation based on Evidence-Based Nursing Practice (EBNP), the KMB Digital Education application was developed to serve as an educational and self-monitoring tool for post-abdominal surgery patients. This application consists of five main modules: wound care, nutrition, mobilization, medication, and red flags, compiled based on the latest clinical guidelines for wound care. In addition to providing interactive information, the application also features a daily checklist and reminder system to help patients maintain adherence to wound care at home (Kurniawati, 2023).

Its design aligns with WHO's Digital Health Framework, emphasizing accessibility, user-centered design, and integration with clinical care pathways.

A preliminary study at Pemangkat Regional Hospital (RSUD Pemangkat) showed that most post-abdominal surgery patients did not understand the importance of comprehensive wound care and lacked structured self-education tools. This finding highlights a gap in the implementation of digital nursing interventions, especially in secondary-level hospitals in Indonesia. Previous studies have largely focused on chronic wound care or diabetic ulcers, while evidence related to post-surgical wound healing remains limited.

Therefore, the implementation of the KMB Digital Education application is expected to be an innovative solution to improve patient compliance and accelerate post-abdominal surgery wound healing. In addition, this study provides empirical evidence regarding the effectiveness of digital health education in rural hospital settings and contributes to the development of EBNP-based nursing innovations in Indonesia.

OBJECTIVE

The general objective of this research is to determine the effect of the KMB Digital Education Application on patient compliance and wound healing among post-abdominal surgery patients at Pemangkat Regional Hospital.

METHODS

Study Design

This research employed a quasi-experimental design with a pretest-posttest control group approach. The study was conducted at Pemangkat Regional Hospital from May to July 2025.. A total of 50 post-abdominal surgery patients were selected using purposive sampling and divided equally into intervention and control groups. The intervention group received education through the KMB Digital Education Application, while the control group received standard postoperative education. Data were collected using observation sheets measuring patient compliance and wound healing progress, and analyzed using the Repeated Measure ANOVA test with a significance level of $p < 0.05$.

Setting

The research was conducted in the surgical ward of Pemangkat Regional Hospital, West Kalimantan, Indonesia, from May to July 2025. The hospital was chosen as the study site because it manages a large number of postoperative abdominal surgery patients and has implemented digital health innovations in patient education.

Research Subject

A total of 50 respondents participated in this study, selected through a purposive sampling technique. The participants were divided equally into two groups, consisting of 25 individuals in the intervention group and 25 individuals in the control group. The inclusion criteria for participation were patients who had undergone abdominal surgery, were conscious and able to communicate effectively, capable of using a smartphone, and willing to take part in the study by providing informed consent. Meanwhile, patients who were in critical condition or unable to operate the digital application were excluded from the study.

Instruments

Data on patient adherence were collected using a validated adherence questionnaire ($r > 0.6$; Cronbach's $\alpha = 0.89$). Wound healing progress was evaluated using the Bates-Jensen Wound Assessment Tool (BWAT), which includes parameters such as wound size, depth, edges, necrotic tissue, exudate, granulation, and epithelialization. Observations were conducted once a week for four consecutive weeks, resulting in a total of four follow-up assessments. All wound observations were carried out directly through the KMB Digital Education Application by trained nurses who monitored and recorded the patients' wound healing progress remotely.

Data Analysis

Univariate analysis was conducted to describe the distribution of respondent characteristics, including age, gender, education level, occupation, and marital status. This analysis aimed to provide an overview of the demographic and baseline characteristics of post-abdominal surgery patients participating in both the intervention and control groups. Descriptive statistics such as frequency, percentage, mean, and standard deviation were used to summarize the data.

Bivariate analysis was performed to determine the effect of the KMB Digital Education Application on patient adherence and wound healing outcomes. The analysis compared differences between the intervention and control groups across four follow-up sessions, conducted once a week over a total period of one month. Data were analyzed using the General Linear Model Repeated Measures ANOVA to examine differences and interactions over time and between groups. A significance level of $p < 0.05$ was applied to identify statistically significant effects.

Ethical Consideration

Ethical approval for this study was obtained from the Health Research Ethics Committee of Pemangkat Regional Hospital (No. 021/KEPK-RSUDP/IV/2025). All participants were informed about the study's purpose, procedures, risks, and benefits before providing written informed consent. Confidentiality, anonymity, and voluntary participation were ensured throughout the research process.

RESULTS

Respondent Characteristics

Based on the results of the study of 50 respondents, it was found that the gender distribution between men and women was balanced, with 25 respondents (50%) each. This indicates that the respondents in this study had an equal proportion of men and women, so there was no gender dominance that could influence the research results.

Based on educational level, the majority of respondents (20 respondents) had a high school education (SMA), while 10 (20%) had a junior high school education (SMP), and 10 (20%) had a diploma 3 (D3). These results indicate that the majority of respondents had a secondary education, which is expected to be sufficient to understand the health education material provided through the KMB Digital Education application.

In terms of occupation, respondents were evenly distributed across several job categories. Ten (20%) were unemployed, ten (20%) were housewives, ten (20%) were civil servants, ten (20%) worked in the private sector, and ten (20%) worked as farmers or fishermen. This distribution indicates that the respondents' occupational backgrounds are quite diverse, reflecting variations in their levels of physical activity and access to technology in their daily lives.

Based on marital status, the majority of respondents were married (30 respondents (41.9%), while 20 (58.1%) were single. This indicates that the majority of respondents had family responsibilities, which could influence their level of attention to their health and compliance with post-operative therapy and wound care.

Tabel 1. Respondent Characteristic

Variable	f	%
Gender		
Man	25	50%
Woman	25	50%
Total	50	100%
Education		
JUNIOR HIGH SCHOOL	10	20%
SENIOR HIGH SCHOOL	30	40.0%
D3	10	20%
Total	50	100%
Work		
Doesn't work	10	20%
Housewife	10	20%
civil servant	10	20%
Private	10	20%
Farmers/Fishermen	10	20%
Total	50	100%
Marital status		
Married	30	41.9%
Not married yet	20	58.1%
Total	50	100%

Table 2. Age

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Standard Deviation
Age	50	21	68	41.96	13,707
Valid (N)	50				

Based on the descriptive analysis, it was found that the ages of the respondents in this study ranged from 21 to 68 years, with an average age of 41.96 years and a standard deviation of 13.71. This indicates that the respondents came from the early to late adulthood age group, with a predominance of middle age.

1. Results of the Repeated Measure ANOVA Test on the Application of the KMB Digital Education Application on Compliance and Wound Healing between the Intervention and Control Groups

Table 3. Implementation of the KMB Digital Education application on Compliance and Wound Healing between the Intervention and Control Groups

Variables	**Source of Variation**	**df**	**Mean Square**	**F**	**Sig.**
Compliance	Group	1	3312.980	641,222	<0.001
	Error	48	5,167	—	—
Wound healing	Group	1	2145.325	392,450	<0.001
	Error	48	5,466	—	—

The analysis showed a significant difference in mean scores between the intervention and control groups for compliance and wound healing variables (p<0.000). This indicates that the implementation of the KMB Digital Education application significantly improved patient compliance and accelerated wound healing after abdominal surgery.

2. Mean Value and Standard Deviation of Patient Compliance Based on Group and Measurement Time

Table 4. Mean Values and Standard Deviations of Patient Compliance Based on Group and Measurement Time

Measurement Time	**Intervention Group (Mean ± SD)**	**Control Group (Mean ± SD)**
Pretest (T1)	31.12 ± 1.20	28.68 ± 1.07
Day 2 (T2)	36.40 ± 1.41	30.20 ± 0.76
Day 3 (T3)	42.28 ± 1.46	31.56 ± 0.87

Measurement Time	Intervention Group (Mean ± SD)	Control Group (Mean ± SD)
Day 4 (T4)	46.44 ± 1.56	33.24 ± 0.97

Based on Table 4, it can be seen that the average patient compliance score in the intervention group increased significantly from pretest (31.12 ± 1.20) to day 4 (46.44 ± 1.56). In contrast, in the control group, the increase in the average compliance was smaller, namely from 28.68 ± 1.07 to 33.24 ± 0.97. This indicates that patients who received education through the KMB Digital Education Application had a higher level of compliance in carrying out wound care than patients who did not receive digital intervention. The results of the Repeated Measure ANOVA test showed a value of $F = 641.222$ with $p < 0.001$, which means there was a significant difference in patient compliance between the intervention and control groups.

3. Wound Healing Based on Group and Measurement Time

Table 5. Mean Values and Standard Deviations of Wound Healing Based on Group and Measurement Time

Measurement Time	Intervention Group (Mean ± SD)	Control Group (Mean ± SD)
Day 1 (F1)	42.32 ± 2.19	42.36 ± 1.87
Day 2 (F2)	35.04 ± 2.03	40.56 ± 1.58
Day 3 (F3)	28.52 ± 2.06	37.80 ± 1.33
Day 4 (F4)	21.84 ± 2.19	36.48 ± 1.16

Based on Table 4, it can be seen that the mean wound healing score in the intervention group experienced a significant decrease from day 1 (42.32 ± 2.19) to day 4 (21.84 ± 2.19). This decrease in score indicates a more rapid improvement in wound condition. In contrast, in the control group, the mean wound healing score decreased more slowly from day 1 (42.36 ± 1.87) to day 4 (36.48 ± 1.16).

The results of the Repeated Measure ANOVA test showed a value of $F = 392.450$ with $p < 0.001$, which means there was a significant difference between the intervention group and the control group in terms of the level of wound healing.

4. Compliance and Wound Healing Rate Graph

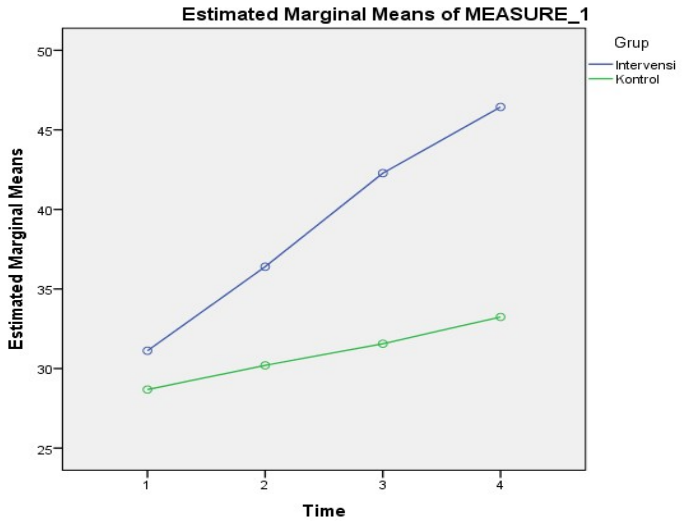

Figure 1. Mean Patient Compliance Scores (Pretest to Day 4).

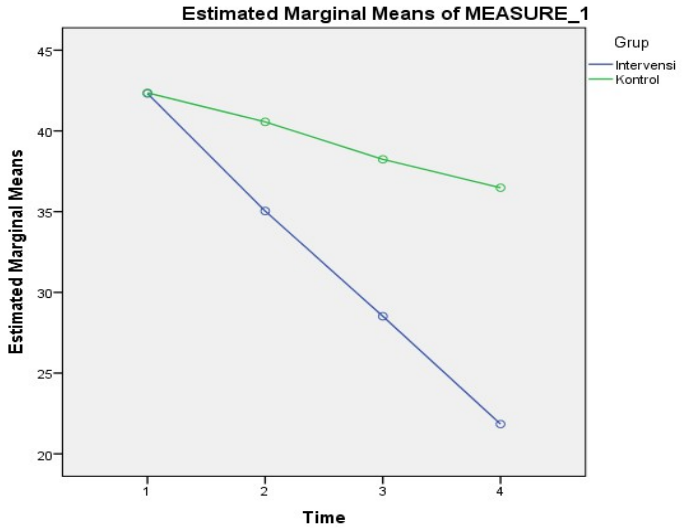

Figure 2. Wound Healing Progress (BWAT Scores)

The graph shows an increase in average patient adherence over time in both intervention and control groups. However, the increase in adherence was significantly higher in the intervention group than in the control group.On the first day, the average adherence between the two groups appeared relatively close. As time progressed (until the fourth day), the intervention group showed a sharp increase to the highest average, while the control group experienced only a relatively small increase.

These findings indicate that the KMB Digital Education Application is effective in improving patient adherence to wound care, as the digital education provided helps patients understand and consistently follow treatment recommendations. These results are in line with the Repeated Measures ANOVA test value which shows $p < 0.001$, meaning there is a

significant difference between the intervention and control groups in improving adherence over time.

DISCUSSION

1. KMB Digital Education Application Regarding Compliance

The results showed a significant increase in patient compliance in the intervention group after receiving education through the KMB Digital Education Application compared to the control group ($p<0.001$). Based on descriptive analysis, the mean compliance score in the intervention group increased consistently from 31.12 in the first measurement to 46.44 in the fourth measurement, with a relatively stable standard deviation (SD = 1.201–1.557). In contrast, the control group only showed a small increase from 28.68 to 33.24. This significantly greater increase in the intervention group illustrates that the use of digital applications can increase patient awareness, independence, and responsibility in carrying out post-abdominal surgery wound care instructions.

In addition to these objective results, patient perceptions of the application also showed high acceptance. Based on the survey results, 43 respondents (86%) agreed that the KMB Digital Education application helped them understand and follow treatment instructions, while only 7 respondents (14%) disagreed. Meanwhile, 39 respondents (78%) felt that the application helped their wound healing process, and only 11 respondents (22%) stated the opposite. These findings indicate that the majority of patients found the application useful and easy to use in supporting self-care. This positive perception also plays an important role in increasing patient motivation and adherence to the treatment program, as explained by the Technology Acceptance Model (TAM) theory that perceived ease of use and perceived usefulness will influence the intention and behavior of using health technology.

The KMB Digital Education app provides an interactive learning experience through modules covering wound education, nutrition, mobilization, and medication. Daily checklists and reminders help patients independently monitor daily adherence, while a monitoring menu allows healthcare professionals to conduct remote supervision. This mechanism creates a two-way feedback loop that reinforces the learning process and motivates patients to maintain consistency. This aligns with the Health Belief Model (HBM), where the app acts as a cue to action, encouraging patients to take preventative measures for wound complications and comply with care instructions.

These results support research Wahyuni, 2025 which reported a 35% increase in surgical patient compliance after being given digital education via a mobile application compared to conventional education. Study Chen (2021) also found that digital interventions increased therapy compliance in postoperative patients due to automatic reminders and easy access to information. In addition, Siregar (2023) proved that a nursing-based educational application increased adherence to wound care behavior by up to 40%.

The consistency of these results indicates that digital educational media can be an effective innovation in strengthening patient compliance behavior in a sustainable manner.

From a nursing perspective, this increase in compliance demonstrates nurses' success in optimizing educational functions through a technological approach. Referring to the Health Promotion Model (Pender, 2022), nurses play a role in facilitating patient motivation and

learning to engage in independent healthy behaviors. The KMB Digital Education application expands this role by providing a learning platform accessible outside the hospital, ensuring continuity of education, and minimizing patient dependence on direct instruction from healthcare professionals.

Thus, the implementation of the KMB Digital Education Application has been proven to improve patient compliance after abdominal surgery, both objectively (compliance score measurement results) and subjectively (perceived benefits and ease of use of the application). Digital-based education not only improves patient understanding of the importance of self-care but also strengthens patient motivation and confidence in carrying out care independently. The implication of these results is the importance of integrating digital education applications into the nursing service system to improve the quality of care, expand the reach of education, and strengthen technology-based continuity of care.

2. The Impact of KMB Digital Education Application on Wound Healing Rate

The analysis results showed that the KMB Digital Education application significantly accelerated wound healing in post-abdominal surgery patients. Based on descriptive results, the mean wound score in the intervention group decreased more rapidly, from 42.32 in the first measurement to 21.84 in the fourth measurement. In contrast, the control group only decreased from 42.36 to 36.48 during the same period. The greater reduction in wound scores in the intervention group indicates that education and monitoring through the application play a significant role in accelerating the wound tissue regeneration process.

The consistent reduction in wound scores over time in the intervention group indicates that patients are able to perform wound care correctly according to the app's guidelines. Features including visual education, daily reminders, and step-by-step instructions help patients maintain wound hygiene, change dressings using aseptic techniques, and maintain a nutritional regimen that supports healing. The app also provides two-way communication between patients and caregivers, allowing patients to regularly report wound conditions and receive prompt feedback on signs of infection or delayed healing.

The accelerated reduction in BWAT scores observed in the intervention group can be attributed to the specific 'Red Flag' and 'Nutrition' modules within the KMB Application. Unlike standard verbal education, the application provides visual references for infection signs (Red Flags), allowing patients to identify complications such as abnormal exudate early. Additionally, the daily checklist feature ensures adherence to high-protein dietary recommendations, which is physiologically essential for collagen synthesis and tissue regeneration. This continuous digital monitoring minimizes the self-care deficit, directly contributing to the faster decline in wound severity scores compared to the control group.

This finding is in line with the Self Care Deficit theory Orem (2021) which explains that individuals who have good educational support and information sources will be able to increase their self-care agency capacity, including in carrying out independent wound care. The KMB Digital Education application acts as a digital self-care support media that increases patients' ability to carry out promotive and preventive actions against wound complications.

This research is also supported by the results of research Zhang (2021) which shows that the use of mobile applications in post-operative wound care education can accelerate

wound healing up to 25% faster than conventional methods. Research Pratiwi (2023) and Sari (2023) also reported that the use of digital-based educational media reduces the level of wound inflammation and accelerates the formation of granulation tissue in post-laparotomy patients. Similar findings were also obtained by Kumar (2022) which explained that digital applications can increase patient regularity in changing dressings, monitoring wound moisture, and reporting complaints in real-time, thereby accelerating the epithelialization process.

From a nursing perspective, these results demonstrate that the use of digital technology can expand the educational and monitoring functions of nurses. Through a digital approach, education can be provided continuously outside the hospital setting, thereby enhancing continuity of care. This supports the concept of nursing informatics, which positions technology as a tool to improve the quality of nursing care.

Thus, the implementation of the KMB Digital Education Application has proven effective in accelerating wound healing in post-abdominal surgery patients. Interactive education, easy access to information, and rapid communication support enable patients to be more consistent in following standardized care. These results highlight the importance of developing and integrating digital applications into nursing practice as an innovative strategy to improve clinical outcomes and quality of life for post-operative patients.

IMPLICATION

The findings of this study imply that the integration of the KMB Digital Education Application can serve as an effective innovation in postoperative nursing care. By utilizing a digital platform containing educational modules, reminders, and monitoring features, patients become more engaged in their recovery process and demonstrate better adherence to wound care instructions. This digital approach enhances nurse–patient interaction, supports continuity of care beyond hospital settings, and promotes faster wound healing outcomes. Hospitals can adopt similar digital education models to improve patient compliance and clinical recovery rates, particularly among surgical patients who require continuous postoperative guidance.

CONCLUSION

This study concludes that the implementation of the KMB Digital Education Application significantly improves patient compliance and accelerates wound healing among post-abdominal surgery patients compared to standard verbal education. The structured modules and reminder system within the application effectively support patients in performing proper wound care, maintaining nutrition, and adhering to mobilization and medication instructions. Thus, the KMB Digital Education Application proves to be a beneficial complementary tool for enhancing the quality and effectiveness of postoperative nursing interventions.

SUGGESTIONS

It is recommended that hospitals and healthcare providers integrate digital education platforms such as the KMB Application into their postoperative care protocols. Nurses should be trained to guide patients in using the application effectively to ensure consistent monitoring and feedback. For nursing education institutions, incorporating digital health technology into

curricula can enhance students' readiness for technology-assisted patient care. Future researchers are encouraged to explore the long-term effects of digital education Interventions on different types of surgical patients and to assess cost-effectiveness, user engagement, and scalability across various healthcare settings.

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CONFLICTS OF INTEREST
Nothing conflict

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